US010496660B1

(12) **United States Patent**
Freund et al.

(10) **Patent No.: US 10,496,660 B1**
(45) **Date of Patent: Dec. 3, 2019**

(54) **SERVING CONTENT ITEMS IN CONTENT ITEM SLOTS BASED ON A REFERRAL QUERY LOCATION**

(71) Applicant: **Google Inc.**, Mountain View, CA (US)

(72) Inventors: **Martin Brandt Freund**, Mountain View, CA (US); **Yuanying Xie**, Mountain View, CA (US)

(73) Assignee: **Google LLC**, Mountain View, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1800 days.

(21) Appl. No.: **14/021,386**

(22) Filed: **Sep. 9, 2013**

(51) **Int. Cl.**
G06Q 30/00 (2012.01)
G06F 16/248 (2019.01)

(52) **U.S. Cl.**
CPC ***G06F 16/248*** (2019.01)

(58) **Field of Classification Search**
USPC 705/14.73, 14.4
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,296,179 B1	10/2012	Rennison		
8,335,721 B2	12/2012	Samdadiya et al.		
2003/0149618 A1 *	8/2003	Sender	G06Q 30/02	705/14.55
2005/0137958 A1 *	6/2005	Huber	G06Q 30/02	705/37
2008/0133314 A1	6/2008	Chiu		
2012/0158705 A1 *	6/2012	Konig	G06F 16/58	707/723
2013/0019202 A1 *	1/2013	Regan	G06F 17/30867	715/810

OTHER PUBLICATIONS

Schroedl et al., Personalized Ad Placement in Web Search, ADKDD'10, Jul. 25, 2010 (9 pgs).

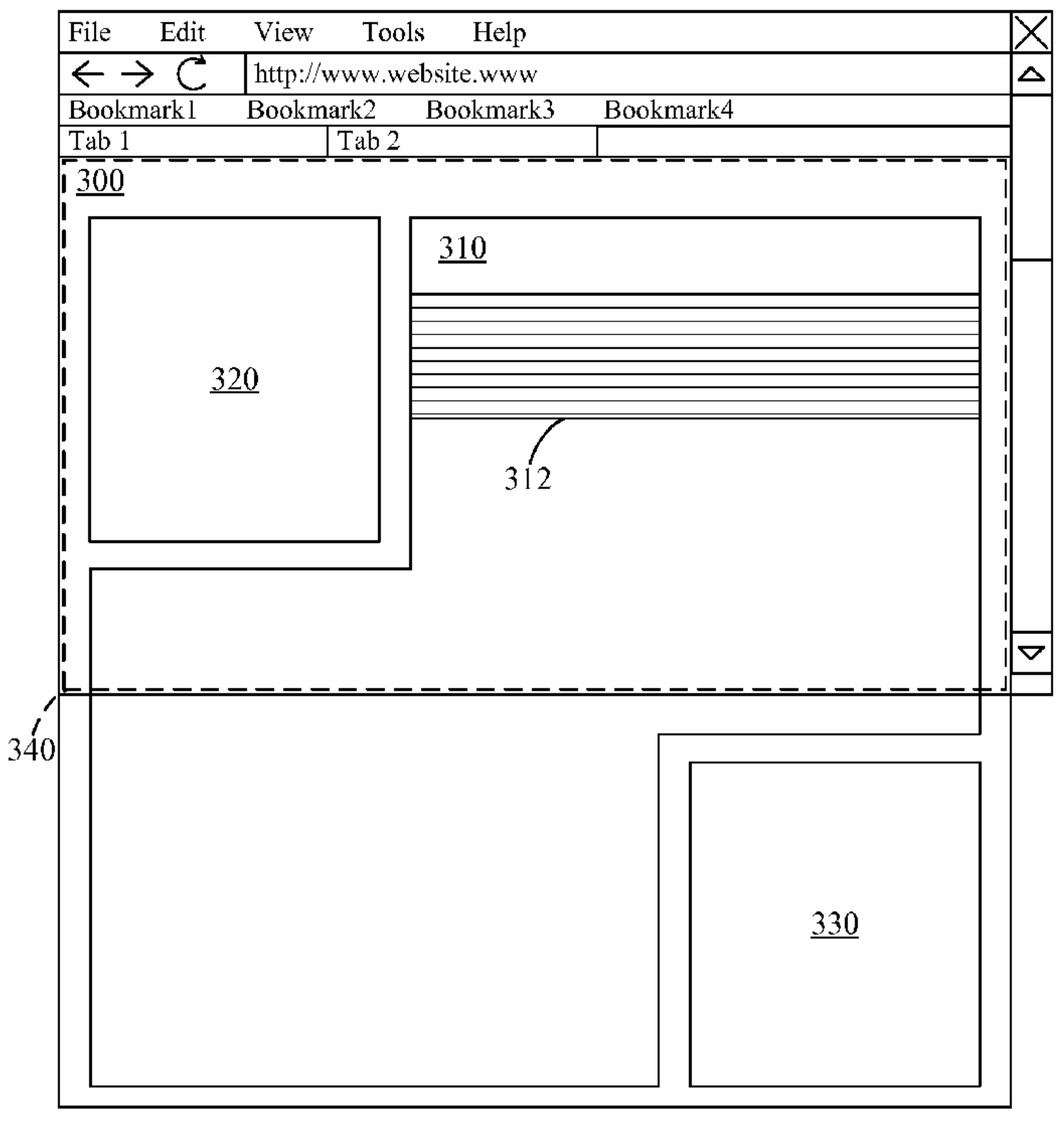
* cited by examiner

Primary Examiner — Sun M Li
(74) *Attorney, Agent, or Firm* — Foley & Lardner LLP

(57) **ABSTRACT**

Content items may be selected and served with a resource such that each content item is displayed in a corresponding content item slot based on a determined order. The determined order may be based on content of the resource and a referral query. A referral query location of the resource may be based on the referral query and data indicative of content of the resource. In some implementations, the determined order may be based on a predictive model and the referral query location. The predictive model may be based on aggregate historical data of interactions. In some implementations, the determined order may be based on a proximity of a content item slot relative to the referral query location.

7 Claims, 8 Drawing Sheets



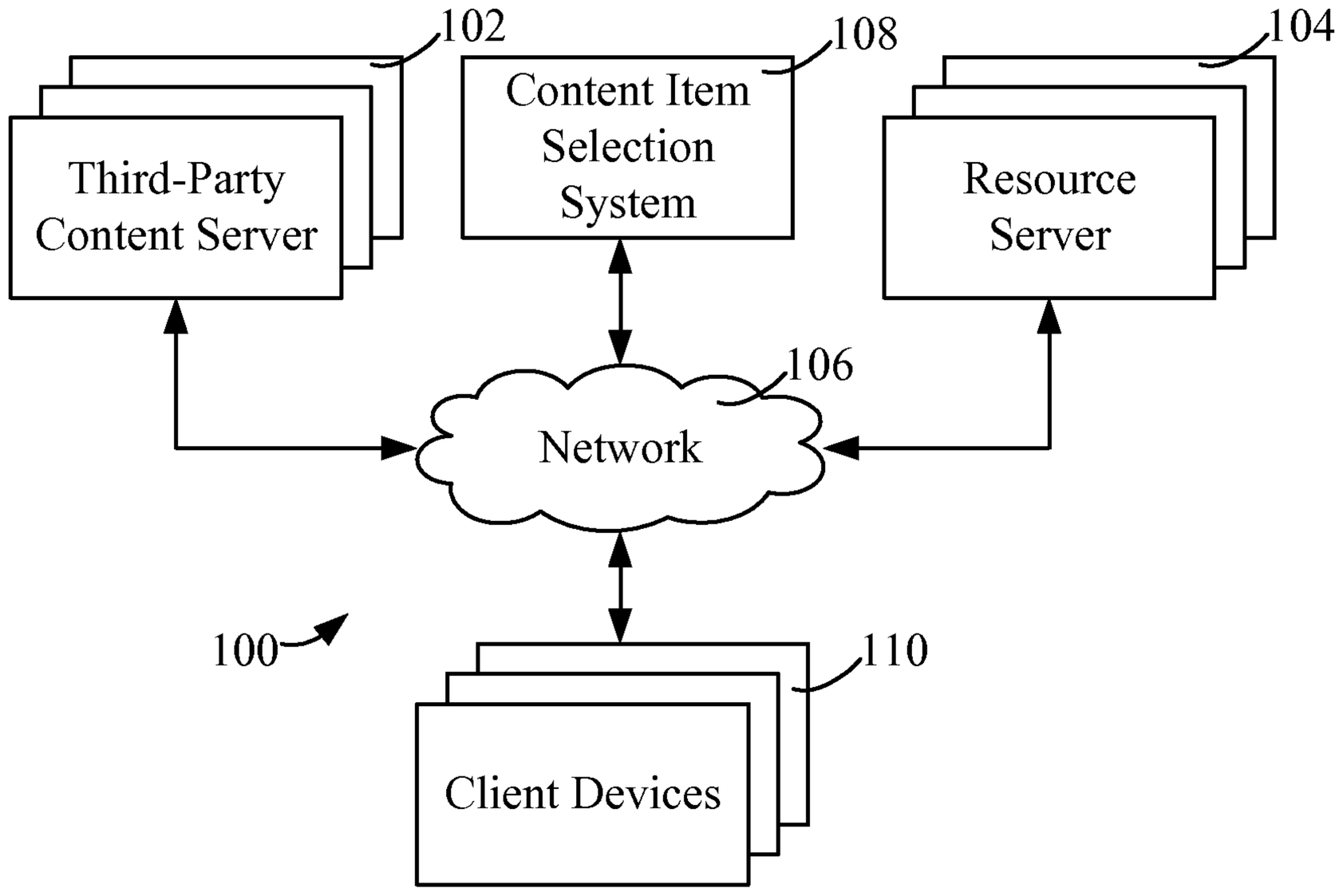

102
Third-Party Content Server
108
Content Item Selection System
104
Resource Server
106
Network
100
110
Client Devices

FIG. 1

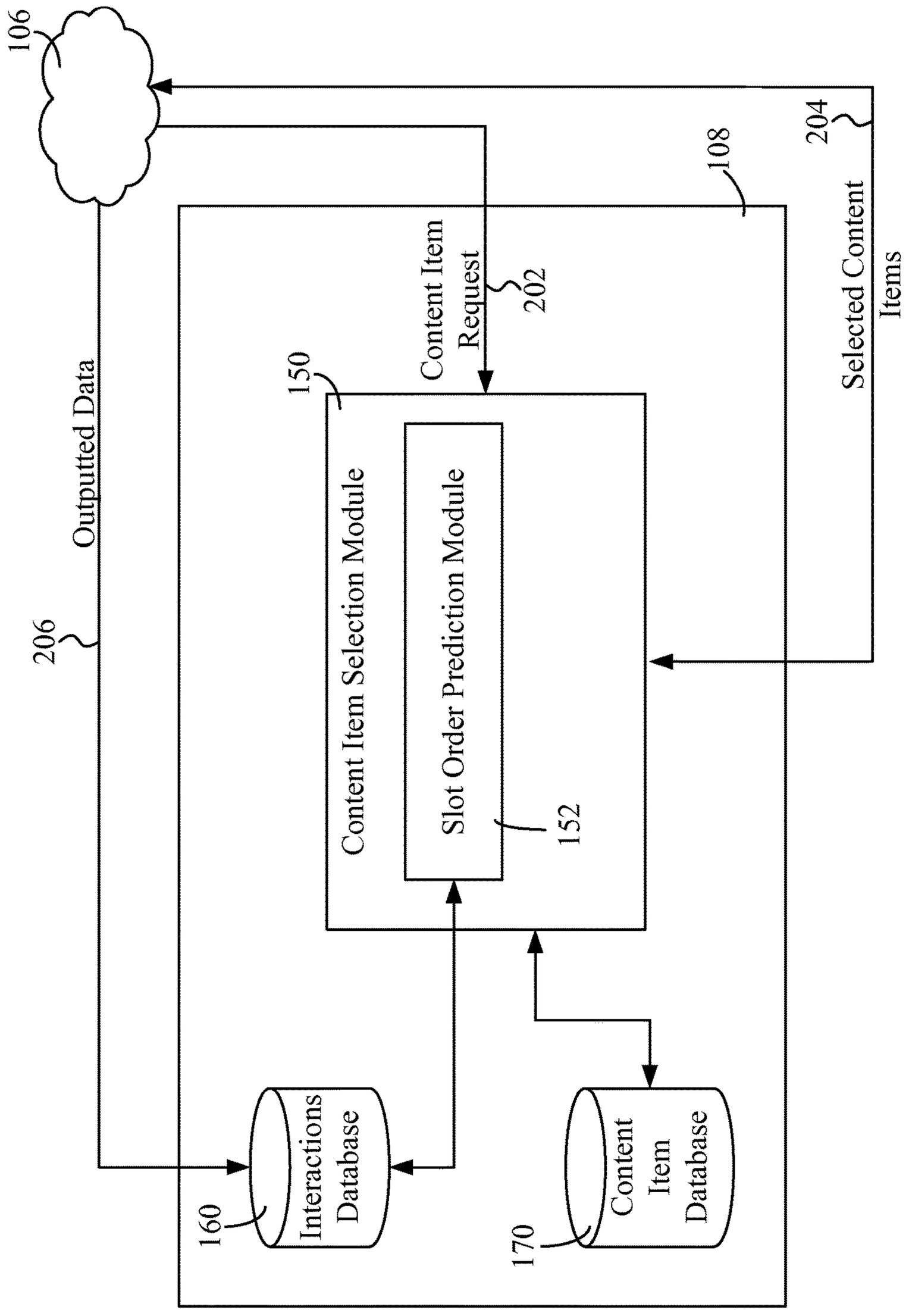

106
204
108
Content Item Request
202
Selected Content Items
206
Outputted Data
150
Content Item Selection Module
Slot Order Prediction Module
152
160
Interactions Database
170
Content Item Database

FIG. 2

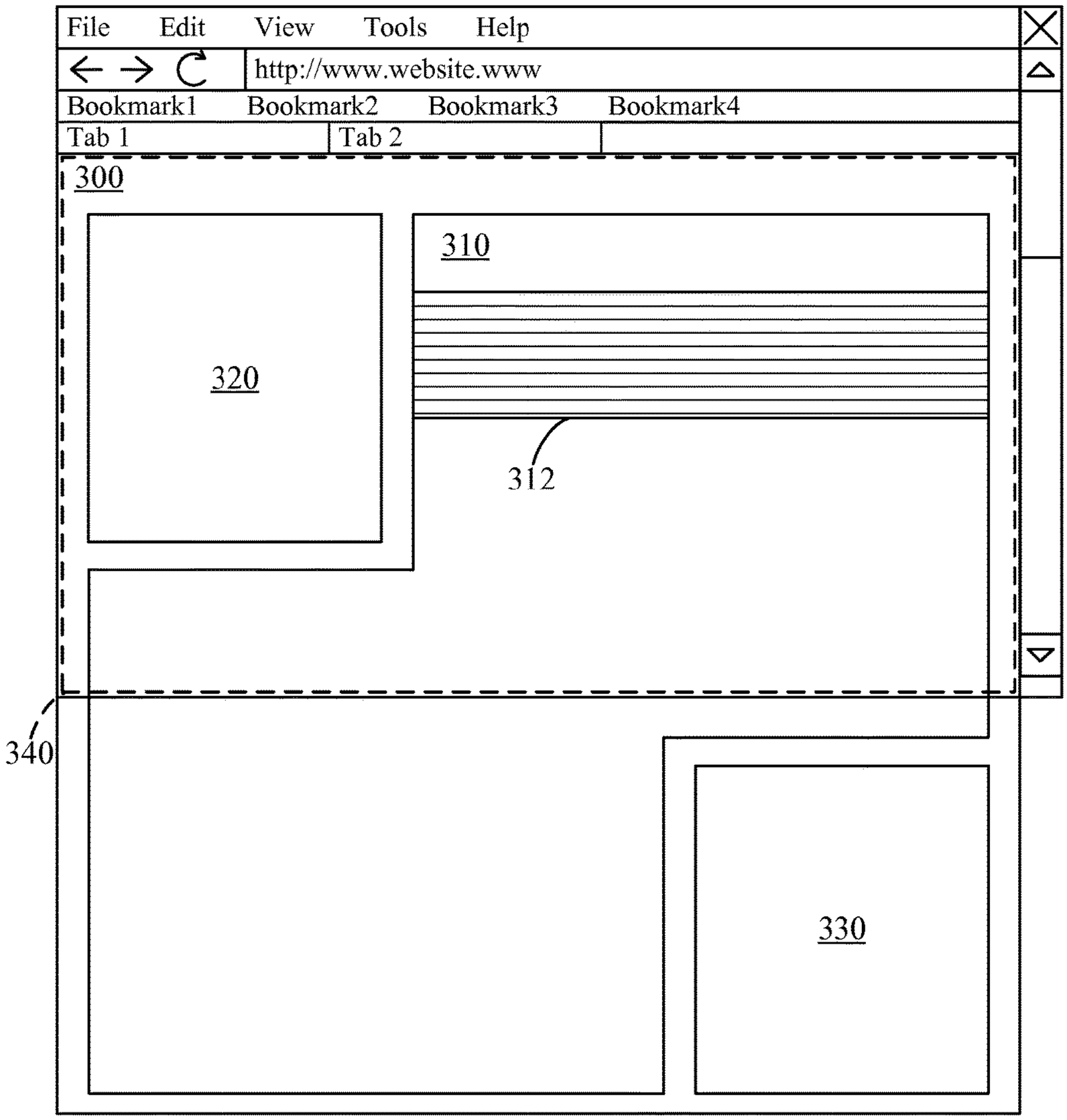

File Edit View Tools Help
http://www.website.www
Bookmark1 Bookmark2 Bookmark3 Bookmark4
Tab 1
Tab 2
300
310
320
312
340
330

FIG. 3

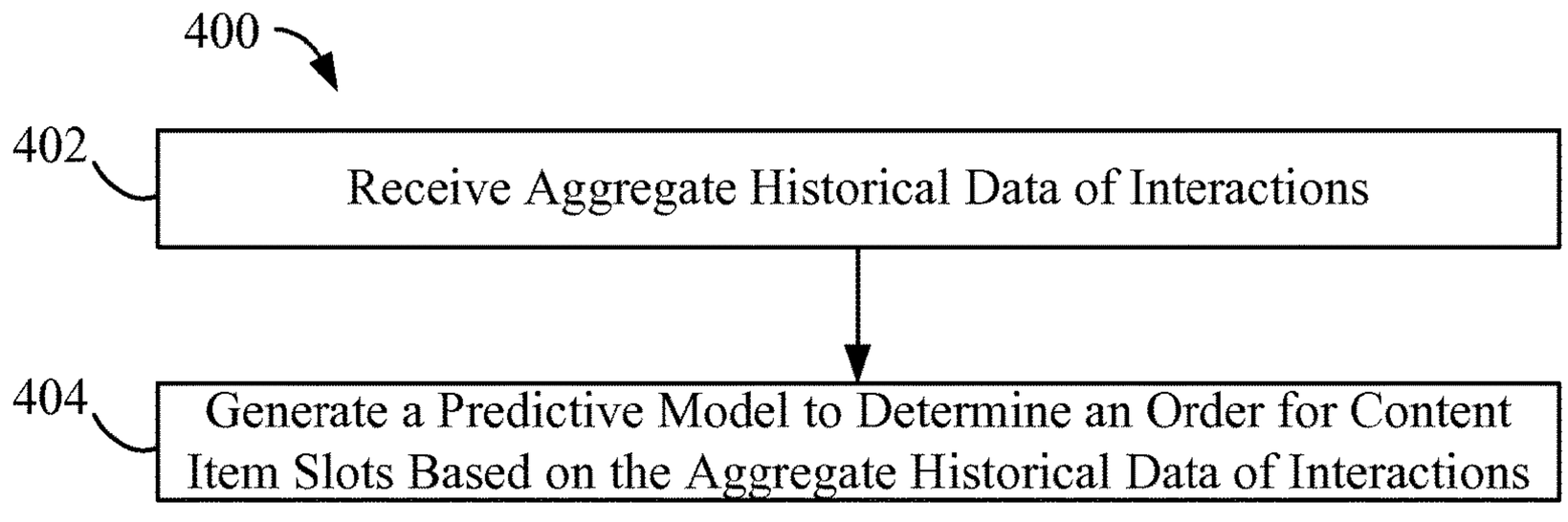

400
402
Receive Aggregate Historical Data of Interactions
404
Generate a Predictive Model to Determine an Order for Content Item Slots Based on the Aggregate Historical Data of Interactions

FIG. 4

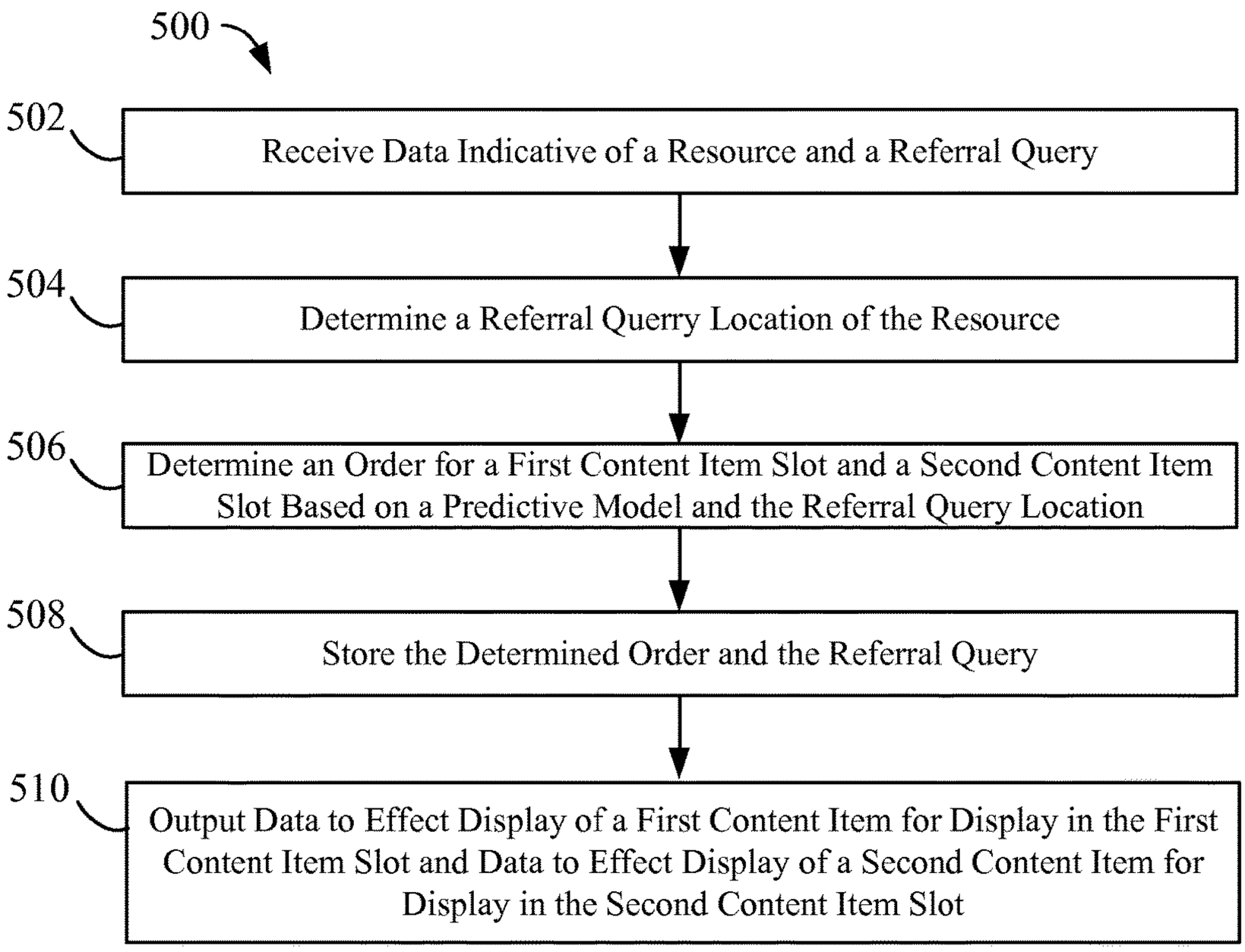

500
502
Receive Data Indicative of a Resource and a Referral Query
504
Determine a Referral Querry Location of the Resource
506
Determine an Order for a First Content Item Slot and a Second Content Item Slot Based on a Predictive Model and the Referral Query Location
508
Store the Determined Order and the Referral Query
510
Output Data to Effect Display of a First Content Item for Display in the First Content Item Slot and Data to Effect Display of a Second Content Item for Display in the Second Content Item Slot

FIG. 5

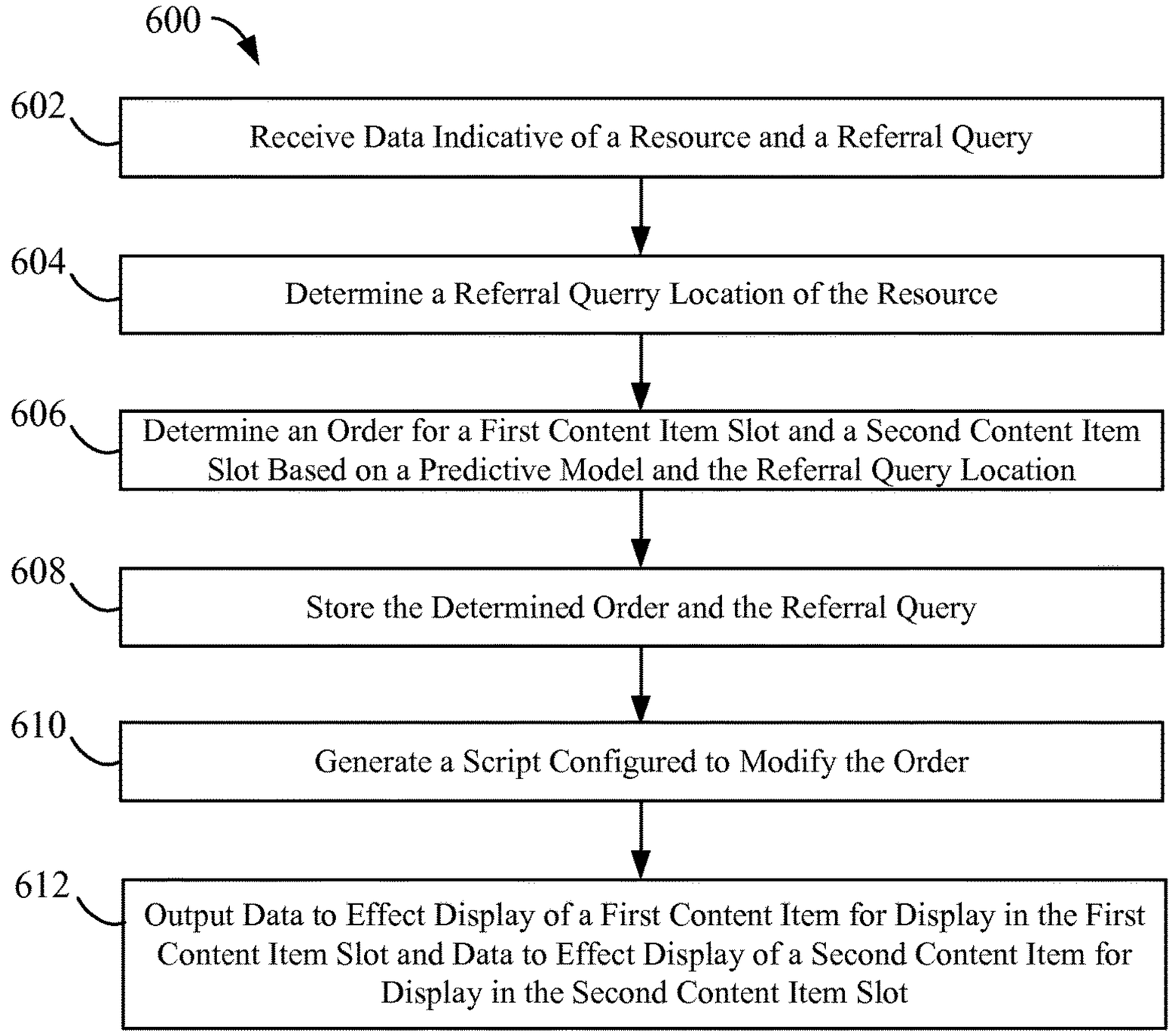

600
602
Receive Data Indicative of a Resource and a Referral Query
604
Determine a Referral Querry Location of the Resource
606
Determine an Order for a First Content Item Slot and a Second Content Item Slot Based on a Predictive Model and the Referral Query Location
608
Store the Determined Order and the Referral Query
610
Generate a Script Configured to Modify the Order
612
Output Data to Effect Display of a First Content Item for Display in the First Content Item Slot and Data to Effect Display of a Second Content Item for Display in the Second Content Item Slot

FIG. 6

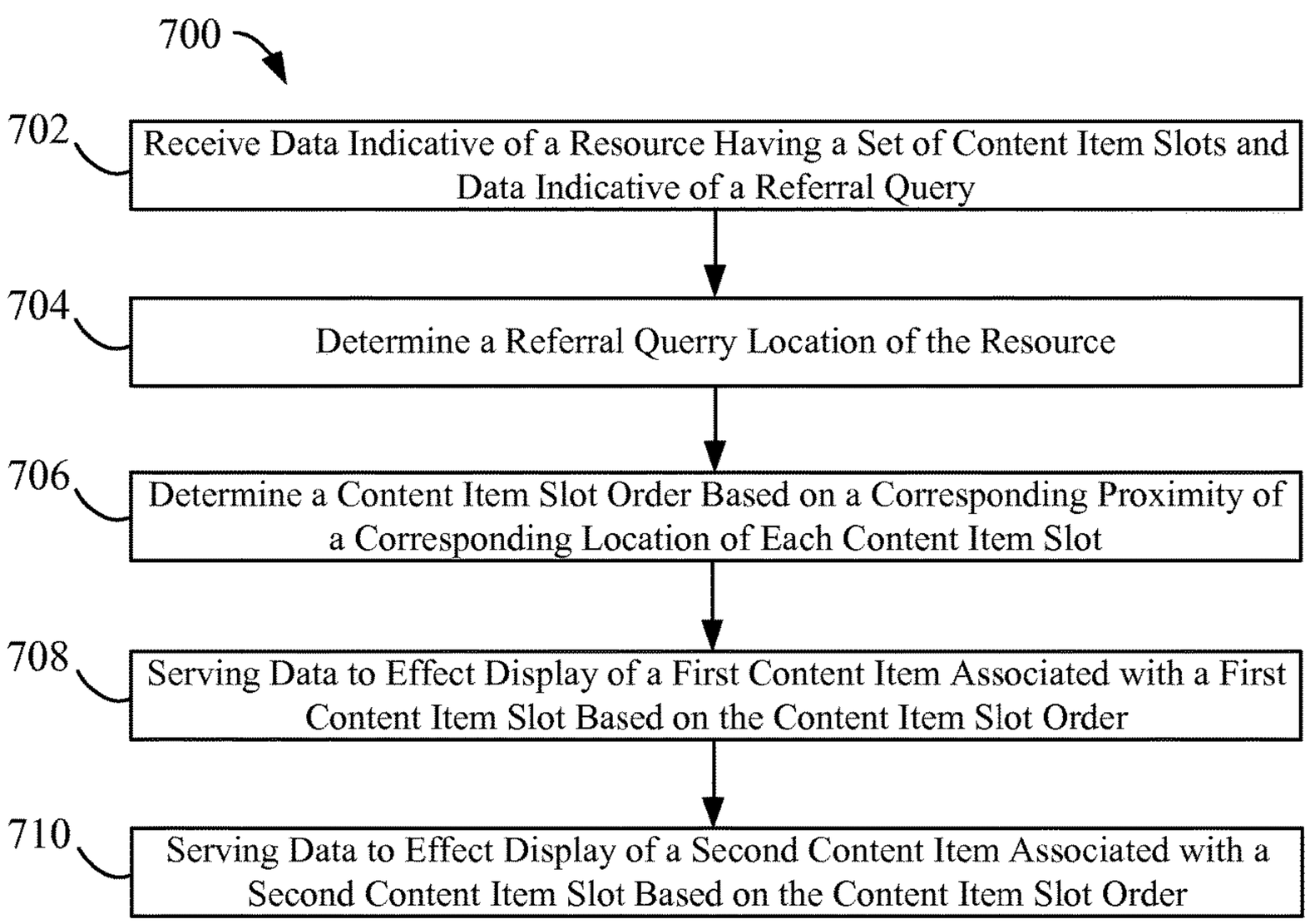

700
702
Receive Data Indicative of a Resource Having a Set of Content Item Slots and Data Indicative of a Referral Query
704
Determine a Referral Querry Location of the Resource
706
Determine a Content Item Slot Order Based on a Corresponding Proximity of a Corresponding Location of Each Content Item Slot
708
Serving Data to Effect Display of a First Content Item Associated with a First Content Item Slot Based on the Content Item Slot Order
710
Serving Data to Effect Display of a Second Content Item Associated with a Second Content Item Slot Based on the Content Item Slot Order

FIG. 7

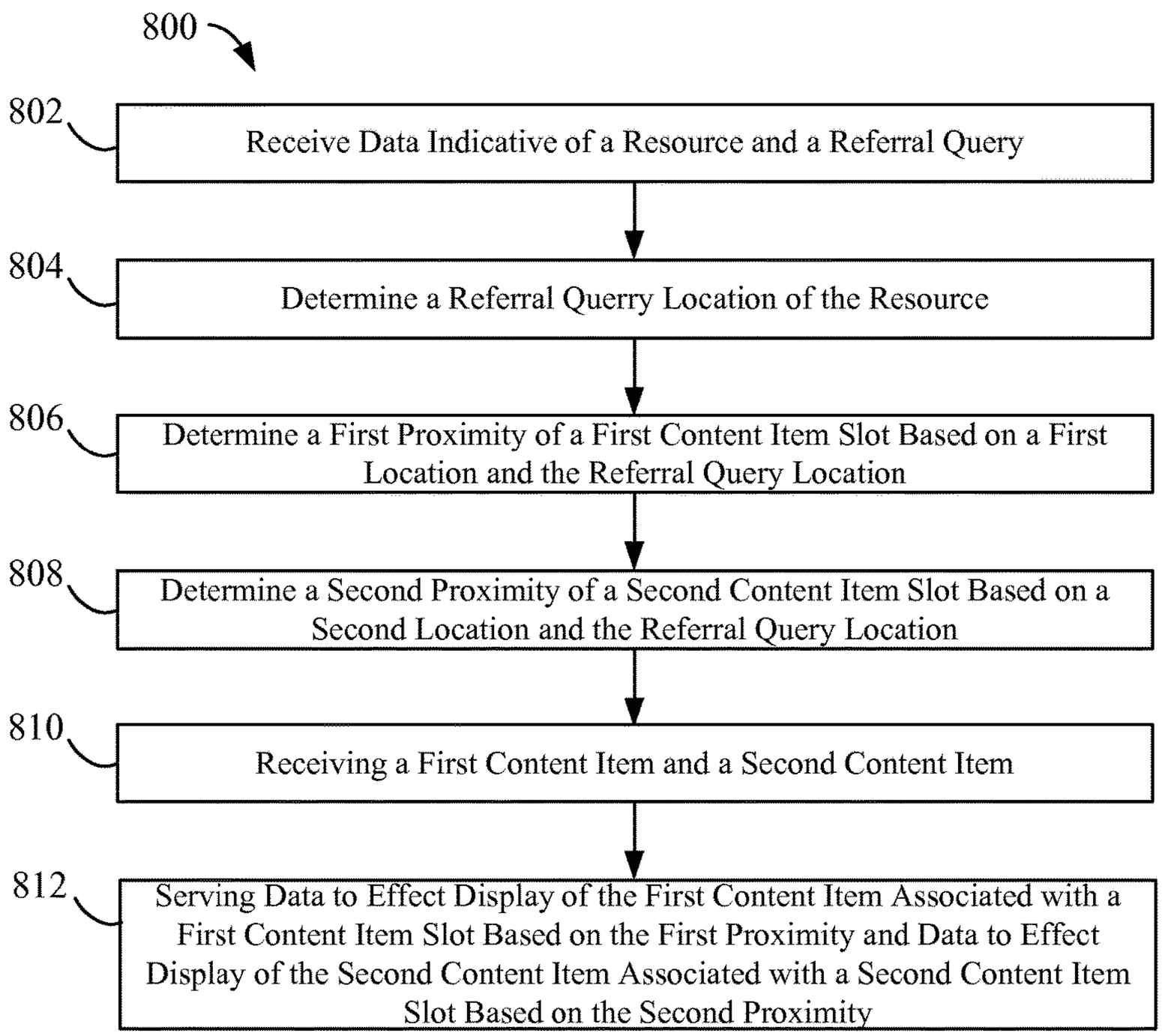

800
802
Receive Data Indicative of a Resource and a Referral Query
804
Determine a Referral Querry Location of the Resource
806
Determine a First Proximity of a First Content Item Slot Based on a First Location and the Referral Query Location
808
Determine a Second Proximity of a Second Content Item Slot Based on a Second Location and the Referral Query Location
810
Receiving a First Content Item and a Second Content Item
812
Serving Data to Effect Display of the First Content Item Associated with a First Content Item Slot Based on the First Proximity and Data to Effect Display of the Second Content Item Associated with a Second Content Item Slot Based on the Second Proximity

FIG. 8

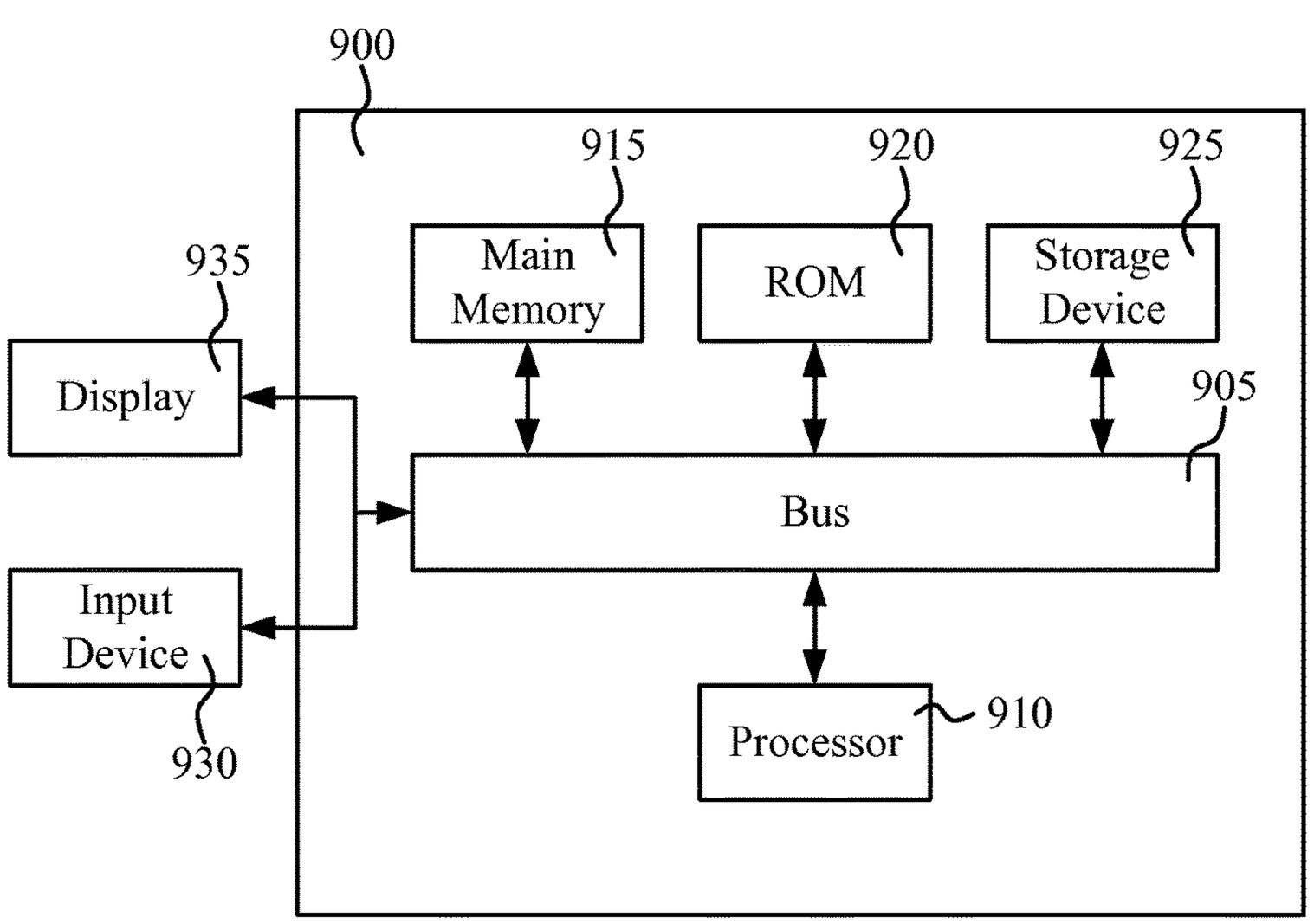

900
915
Main Memory
920
ROM
925
Storage Device
935
Display
905
Bus
Input Device
930
Processor
910

FIG. 9

SERVING CONTENT ITEMS IN CONTENT ITEM SLOTS BASED ON A REFERRAL QUERY LOCATION

BACKGROUND

In a networked environment, such as the Internet or other networks, first-party content providers can provide information for public presentation on resources, for example web pages, documents, applications, and/or other resources. The first-party content can include text, video, and/or audio information provided by the first-party content providers via, for example, a resource server for presentation on a client device over the Internet. Additional third-party content can also be provided by third-party content providers for presentation on the client device together with the first-party content provided by the first-party content providers. Thus, a person viewing a resource can access the first-party content that is the subject of the resource, as well as the third-party content that may or may not be related to the subject matter of the resource.

SUMMARY

One implementation relates to a method of serving content items in content item slots. The method includes receiving data indicative of a resource and a referral query. The resource includes a first content item slot and a second content item slot. A referral query location of the resource may be determined based on the referral query and data indicative of content of the resource. An order of the first content item slot and the second content item slot may be determined based on a predictive model and the referral query location. The predictive model may be based, at least in part, on aggregate historical data of interactions with the resource, and the first content item slot may be before the second content item slot in the order. Data to effect display of a first content item to be displayed in the first content item slot and data to effect display of a second content item to be displayed in the second content item slot may be transmitted. The first content item may be associated with a first value and the second content item may be associated with a second value with the first value being greater than the second value.

Another implementation relates to a system for serving content items in content item slots. The system includes one or more processing modules and one or more storage devices storing instructions that, when executed by the one or more processing modules, cause the one or more processing modules to perform several operations. The operations include receiving data indicative of a resource and a referral query. The resource may include a set of content item slots with each content item slot of the set of content item slots being associated with a corresponding location in the resource. The operations also include determining a referral query location of the resource based on the referral query and data indicative of content of the resource. The operations further include determining a content item slot order for the set of content item slots based, at least in part, on a corresponding proximity of the corresponding location of each content item slot of the set of content item slots to the referral query location. The operations still further include serving, to a client device, data to effect display of a first content item. The first content item may be associated with a first content item slot based on the content item slot order and the first content item may be selected based, at least in part, on a value from a content item auction.

Yet another implementation relates to a computer readable storage device storing instructions that, when executed by one or more processing modules, cause the one or more processing modules to perform several operations. The operations include receiving data indicative of a resource and a referral query. The resource may include a first content item slot at a first location and a second content item slot at a second location. The operations also include determining a referral query location of the resource based on the referral query and data indicative of content of the resource. The operations further include determining a first proximity of the first location relative to the referral query location and determining a second proximity of the second location relative to the referral query location. The first proximity may be less than the second proximity. The operations still further include receiving a first content item and a second content item. The operations also include serving, to a client device, data to effect display of the first content item and data to effect display of the second content item. The first content item may be associated with the first content item slot based, at least in part, on the determined first proximity, and the second content item may be associated with the second content item slot based, at least in part, on the determined second proximity.

BRIEF DESCRIPTION OF THE DRAWINGS

The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features, aspects, and advantages of the disclosure will become apparent from the description, the drawings, and the claims, in which:

FIG. **1** is a block diagram depicting an implementation of a system for providing information via a network;

FIG. **2** is block diagram depicting an implementation of a content item selection system;

FIG. **3** is an overview depicting an implementation of a resource having several content item slots, first-party content, and a referral query location;

FIG. **4** is a flow diagram of an implementation of a process for generating a predictive model based on aggregate historical data of interactions;

FIG. **5** is a flow diagram of an implementation of a process for determining an order for content item slots based on a predictive model and a referral query location and serving selected content items in the content item slots based on the determined order;

FIG. **6** is a flow diagram of an implementation of a process for determining an order for content item slots based on a predictive model and a referral query location, serving selected content items in the content item slots based on the determined order, and generating a script to modify the order;

FIG. **7** is a flow diagram of an implementation of a process for determining an order for content item slots based on a proximity of the content item slot to the referral query location and serving selected content items in the content item slots based on the determined order;

FIG. **8** is a flow diagram of an implementation of a process for serving selected content items in the content item slots based on a proximity of a content item slot to a referral query location; and

FIG. **9** is a block diagram illustrating a general architecture for a computer system that may be employed to implement various elements of the systems and methods described and illustrated herein.

It will be recognized that some or all of the figures are schematic representations for purposes of illustration. The figures are provided for the purpose of illustrating one or more embodiments with the explicit understanding that they will not be used to limit the scope or the meaning of the claims.

DETAILED DESCRIPTION

Following below are more detailed descriptions of various concepts related to, and implementations of, methods, apparatuses, and systems for providing information on a computer network. The various concepts introduced above and discussed in greater detail below may be implemented in any of numerous ways, as the described concepts are not limited to any particular manner of implementation. Examples of specific implementations and applications are provided primarily for illustrative purposes.

A computing device (e.g., a client device) can view a resource, such as a web page, via the Internet by communicating with a server, such as a web page server, corresponding to that resource. The resource includes first-party content that is the subject of the resource from a first-party content provider, as well as additional third-party provided content, such as advertisements or other content. In one implementation, responsive to receiving a request to access a web page, a web page server and/or a client device can communicate with a data processing system, such as a content item selection system, to request a content item to be presented with the requested web page. The content item selection system can select a third-party content item and provide data to effect presentation of the content item with the requested web page on a display of the client device. In some instances, the content item is selected and served with a resource associated with a search query. For example, a search engine may return search results on a search results web page and may include third-party content items related to the search query in one or more content item slots of the search results web page.

In some instances, a device identifier is associated with the client device. The device identifier may include a randomized number associated with the client device to identify the device during subsequent requests for resources and/or content items. In some instances, the device identifier is configured to store and/or cause the client device to transmit information related to the client device to the content item selection system and/or resource server (e.g., a web browser type, an operating system, prior resource requests, prior content item requests, etc.).

In situations in which the systems discussed here collect personal information about users, or may make use of personal information, the users may be provided with an opportunity to control whether programs or features collect user information (e.g., information about a user's social network, social actions or activities, profession, a user's preferences, or a user's current location), or to control whether and/or how to receive content from the content server that may be more relevant to the user. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over how information is collected about the user and used by a content server.

A third-party content provider, when providing third-party content items for presentation with requested resources via the Internet or other network, may utilize a content item management service to control or otherwise influence the selection and serving of the third-party content items. For instance, a third-party content provider may specify selection criteria (such as keywords) and corresponding bid values that are used in the selection of the third-party content items. The bid values may be utilized by the content item selection system in an auction to select and serve content items for display with a resource. For example, a third-party content provider may place a bid in the auction that corresponds to an agreement to pay a certain amount of money if a user interacts with the provider's content item (e.g., the provider agrees to pay $3 if a user clicks on the provider's content item). In other implementations, a third-party content provider may place a bid in the auction that corresponds to an agreement to pay a certain amount of money if the content item is selected and served (e.g., the provider agrees to pay $0.005 each time a content item is selected and served). In some instances, the content item selection system uses content item interaction data to determine the performance of the third-party content provider's content items. For example, users may be more inclined to click on third-party content items on certain web pages over others. Accordingly, auction bids to place the third-party content items may be higher for high-performing web pages, categories of web pages, and/or other criteria, while the bids may be lower for low-performing web pages, categories of web pages, and/or other criteria.

In some instances, a web page or other resource (such as, for example, an application) includes one or more content item slots in which a selected and served third-party content item may be displayed. The code (e.g., JavaScript®, HTML, etc.) defining a content item slot for a web page or other resource may include instructions to request a third-party content item from the content item selection system to be displayed with the web page.

In some instances, a resource, such as a first-party content page, may be selected to be displayed from a search results page. A user of a client device may use an input device to select a hyperlink associated with the desired resource. The hyperlinks displayed on the search result page are determined based on a search query input by the user into an interface of a search engine. Accordingly, the resource contains content, such as first-party content, that, based on a search algorithm, is relevant to the search query. The hyperlinks may also be displayed on the search result page with portions of the content of the resource associated with the hyperlink displayed. Thus, the selection of the hyperlink may be based, at least in part, on the portions of the content displayed on the search result page.

When the hyperlink is selected, the context of the search query may be lost (e.g., the selection of the hyperlink to access the resource does not include the context for why the resource was relevant). In other implementations, the search query may be used as a referral query (e.g., the query that resulted in a user of the client device selecting the hyperlink). In some implementations, the referral query is used, at least in part, in the selection of third-party content items to be displayed with the resource. In some instances, it may be useful to determine a referral query location of the resource. That is, the portion of the content of the resource that is most relevant to the referral query.

For complex search queries, such as long-tail queries, a user of a client device may be searching for some specific information. For example, such a long-tail query may be "When and where was Albert Einstein born?" Such a search query may return several resources containing content related to Albert Einstein, but the user is specifically interested in the information of the date and location of his birth. When the user of the client device selects (e.g., clicks) on a displayed search result hyperlink, the user will most likely scroll, using an input device, to the specific portion of the resource where the information most responsive to the query is located. If the search query is very specific, then the information may be located deep within the content of the resource and not necessarily near the top of the resource. Accordingly, it may be useful to determine an order for the content item slots of a resource such that the highest bidding, most relevant, and/or highest scored content items are displayed in content item slots such that the user of the client device will view the content items.

In some implementations, the referral query location of the resource may be used to determine an order for content item slots of the resource. For example, a content item slot that is near in proximity to the referral query location may have a high rank in the order while a content item slot that is far in proximity to the referral location may have a low rank in the order. In addition to the ordering based on proximity, in some implementations a predictive model may be used to modify the order based on aggregated historical data for interactions with the resource. For example, users interacting with the resource with similar referral query locations may tend to scroll to the location of the referral query location and proceed to scroll downward while rarely scrolling upward. Accordingly, a content item slot that is located further in proximity from the referral query location, but downward from the referral query location may have an increased rank based on the output of the predictive model compared to a content item slot that is located nearer in proximity to the referral query location, but upward from the referral query location.

A content item selection system may utilize the determined order for the content item slots to select and serve content items to be displayed with the resource. In one implementation, the content item selection system may select content items based on bid values and the determined order. In other implementations, the content item selection system may select content items based the determined order and other values, such as predicted click-through-rate (pCTR), predicted conversion rate (pCVR), etc. Display data for the selected content items may be transmitted to a client device to be displayed in the content item slots.

In some implementations, a script may be generated and transmitted with the display data for the selected content items. The script may be configured to modify the content items presented in the content item slots of the resource. For example, the script may receive a user interaction with an input device, such as a mouse scroll, and modify which content items are displayed in which content item slots based on the received user interaction. That is, when a user scrolls upward relative to a referral query location, the script may cause the a content item to be displayed in a content item slot that is located upward relative to the referral query location.

While the foregoing has provided an overview of a content item selection system that determines an order for content item slots based on a predictive model, more specific implementations and systems for such a system will now be described.

FIG. **1** is a block diagram of an implementation of a system **100** for providing information via at least one computer network such as the network **106**. The network **106** may include a local area network (LAN), wide area network (WAN), a telephone network, such as the Public Switched Telephone Network (PSTN), a wireless link, an intranet, the Internet, or combinations thereof. The system **100** can also include at least one data processing system or processing module, such as a content item selection system **108**. The content item selection system **108** can include at least one logic device, such as a computing device having a data processor, to communicate via the network **106**, for example with a resource server **104**, a client device **110**, and/or a third-party content server **102**. The content item selection system **108** can include one or more data processors, such as a content placement processor, configured to execute instructions stored in a memory device to perform one or more operations described herein. In other words, the one or more data processors and the memory device of the content item selection system **108** may form a processing module. The processor may include a microprocessor, an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), etc., or combinations thereof. The memory may include, but is not limited to, electronic, optical, magnetic, or any other storage or transmission device capable of providing processor with program instructions. The memory may include a floppy disk, compact disc read-only memory (CD-ROM), digital versatile disc (DVD), magnetic disk, memory chip, read-only memory (ROM), random-access memory (RAM), Electrically Erasable Programmable Read-Only Memory (EEPROM), erasable programmable read only memory (EPROM), flash memory, optical media, or any other suitable memory from which processor can read instructions. The instructions may include code from any suitable computer programming language such as, but not limited to, ActionScript®, C, C++, C#, HTML, Java®, JavaScript®, Perl®, Python®, Visual Basic®, and XML. The processing module may process instructions and output data to effect presentation of one or more content items to the resource server **104** and/or the client device **110**. In addition to the processing circuit, the content item selection system **108** may include one or more databases configured to store data. The content item selection system **108** may also include an interface configured to receive data via the network **106** and to provide data from the content item selection system **108** to any of the other devices on the network **106**. The content item selection system **108** can include a server, such as an advertisement server or otherwise.

The client device **110** can include one or more devices such as a computer, laptop, desktop, smart phone, tablet, personal digital assistant, set-top box for a television set, a smart television, or server device configured to communicate with other devices via the network **106**. The device may be any form of portable electronic device that includes a data processor and a memory, i.e., a processing module. The memory may store machine instructions that, when executed by a processor, cause the processor to perform one or more of the operations described herein. The memory may also store data to effect presentation of one or more resources, content items, etc. on the computing device. The processor may include a microprocessor, an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), etc., or combinations thereof. The memory may include, but is not limited to, electronic, optical, magnetic, or any other storage or transmission device capable of providing processor with program instructions. The memory

may include a floppy disk, compact disc read-only memory (CD-ROM), digital versatile disc (DVD), magnetic disk, memory chip, read-only memory (ROM), random-access memory (RAM), Electrically Erasable Programmable Read-Only Memory (EEPROM), erasable programmable read only memory (EPROM), flash memory, optical media, or any other suitable memory from which processor can read instructions. The instructions may include code from any suitable computer programming language such as, but not limited to, ActionScript®, C, C++, C#, HTML, Java®, JavaScript®, Perl®, Python®, Visual Basic®, and XML.

The client device **110** can execute a software application (e.g., a web browser or other application) to retrieve content from other computing devices over network **106**. Such an application may be configured to retrieve first-party content from a resource server **104**. In some cases, an application running on the client device **110** may itself be first-party content (e.g., a game, a media player, etc.). In one implementation, the client device **110** may execute a web browser application which provides a browser window on a display of the client device. The web browser application that provides the browser window may operate by receiving input of a uniform resource locator (URL), such as a web address, from an input device (e.g., a pointing device, a keyboard, a touch screen, or another form of input device). In response, one or more processors of the client device executing the instructions from the web browser application may request data from another device connected to the network **106** referred to by the URL address (e.g., a resource server **104**). The other device may then provide web page data and/or other data to the client device **110**, which causes visual indicia to be displayed by the display of the client device **110**. Accordingly, the browser window displays the retrieved first-party content, such as web pages from various websites, to facilitate user interaction with the first party content.

The resource server **104** can include a computing device, such as a server, configured to host a resource, such as a web page or other resource (e.g., articles, comment threads, music, video, graphics, search results, information feeds, etc.). The resource server **104** may be a computer server (e.g., a file transfer protocol (FTP) server, file sharing server, web server, etc.) or a combination of servers (e.g., a data center, a cloud computing platform, etc.). The resource server **104** can provide resource data or other content (e.g., text documents, PDF files, and other forms of electronic documents) to the client device **110**. In one implementation, the client device **110** can access the resource server **104** via the network **106** to request data to effect presentation of a resource of the resource server **104**.

One or more third-party content providers may have third-party content servers **102** to directly or indirectly provide data for third-party content items to the content item selection system **108** and/or to other computing devices via network **106**. The content items may be in any format that may be presented on a display of a client device **110**, for example, graphical, text, image, audio, video, etc. The content items may also be a combination (hybrid) of the formats. The content items may be banner content items, interstitial content items, pop-up content items, rich media content items, hybrid content items, Flash® content items, cross-domain iframe content items, etc. The content items may also include embedded information such as hyperlinks, metadata, links, machine-executable instructions, annotations, etc. In some instances, the third-party content servers **102** may be integrated into the content item selection system **108** and/or the data for the third-party content items may be stored in a database of the content item selection system **108**.

In one implementation, the content item selection system **108** can receive, via the network **106**, a request for a content item to present with a resource. The received request may be received from a resource server **104**, a client device **110**, and/or any other computing device. The resource server **104** may be owned or ran by a first-party content provider that may include instructions for the content item selection system **108** to provide third-party content items with one or more resources of the first-party content provider on the resource server **104**. In one implementation, the resource may include a web page. The client device **110** may be a computing device operated by a user (represented by a device identifier), which, when accessing a resource of the resource server **104**, can make a request to the content item selection system **108** for content items to be presented with the resource, for instance. The content item request can include requesting device information (e.g., a web browser type, an operating system type, one or more previous resource requests from the requesting device, one or more previous content items received by the requesting device, a language setting for the requesting device, a geographical location of the requesting device, a time of a day at the requesting device, a day of a week at the requesting device, a day of a month at the requesting device, a day of a year at the requesting device, etc.) and resource information (e.g., URL of the requested resource, one or more keywords of the content of the requested resource, text of the content of the resource, a title of the resource, a category of the resource, a type of the resource, a referral query, etc.). The information that the content item selection system **108** receives can include a HyperText Transfer Protocol (HTTP) cookie which contains a device identifier (e.g., a random number) that represents the client device **110**. In some implementations, the device information and/or the resource information may be appended to a content item request URL (e.g., http://contentitem.item/page/contentitem?devid=abc123&devnfo=A34r0). In some implementations, the device information and/or the resource information may be encoded prior to being appended the content item request URL. The requesting device information and/or the resource information may be utilized by the content item selection system **108** to select third-party content items to be served with the requested resource and presented on a display of a client device **110**.

In some instances, a resource of a resource server **104** may include a search engine feature. The search engine feature may receive a search query (e.g., a string of text) via an input feature (an input text box, etc.). The search engine may search an index of documents (e.g., other resources, such as web pages, etc.) for relevant search results based on the search query. The search results may be transmitted as a second resource to present the relevant search results, such as a search result web page, on a display of a client device **110**. The search results may include web page titles, hyperlinks, etc. One or more third-party content items may also be presented with the search results in a content item slot of the search result web page. Accordingly, the resource server **104** and/or the client device **110** may request one or more content items from the content item selection system **108** to be presented in the content item slot of the search result web page. The content item request may include additional information, such as the client device information, the resource information, a quantity of content items, a format for the content items, the search query string, keywords of the search query string, information related to the query

(e.g., geographic location information and/or temporal information), etc. In some implementations, a delineation may be made between the search results and the third-party content items to avert confusion.

In some implementations, the third-party content provider may manage the selection and serving of content items by content item selection system **108**. For example, the third-party content provider may set bid values and/or selection criteria via a user interface that may include one or more content item conditions or constraints regarding the serving of content items. A third-party content provider may specify that a content item and/or a set of content items should be selected and served for client devices **110** having device identifiers associated with a certain geographic location or region, a certain language, a certain operating system, a certain web browser, etc. In another implementation, the third-party content provider may specify that a content item or set of content items should be selected and served when the resource, such as a web page, document, etc., contains content that matches or is related to certain keywords, phrases, etc. The third-party content provider may set a single bid value for several content items, set bid values for subsets of content items, and/or set bid values for each content item. The third-party content provider may also set the types of bid values, such as bids based on whether a user clicks on the third-party content item, whether a user performs a specific action based on the presentation of the third-party content item, whether the third-party content item is selected and served, and/or other types of bids.

Referring now to FIG. **2**, portions of the content item selection system **108** are shown in more detail. In the implementation depicted in FIG. **2**, the content item selection system **108** includes a content item selection module **150**, an interactions database **160**, and a content item database **170**. The content item selection module **150** includes a slot order prediction module **152**. While the implementation shown in FIG. **2** depicts the interactions database **160** and the content item database **170** as separate databases, it should be understood that the databases may be combined into a single database or sets of databases.

The content item selection module **150** is configured to receive a content item request **202** via the network **106**. A client device, such as client device **110** of FIG. **1**, or a resource server, such as resource server **104**, may send the content item request **202** to the content item selection system **108** via the network **106**. The content item request **202** may include one or more characteristics of the client device (e.g., a type of client device, a display type of a client device, dimensions of the display), characteristics of a web browser executed on the client device (e.g., a type of web browser), settings associated with the client device (e.g., a display resolution), settings associated with the web browser executed on the client device (e.g., a height of a web browser window, a width of a web browser window, a text size setting of the web browser of the client device, a font setting of the web browser, a zoom setting of the web browser, a dimension of one or more toolbar portions of the web browser, a dimension of one or more navigation and address portions of the web browser, a dimension of one or more bookmark portions of the web browser, a dimension of one or more tab portions of the web browser, a number of tabs open in the web browser, a dimension of a scroll bar of the web browser, formulae derived from dimensions of a web browser window and/or location of an area where a content item may be shown), a referral query, and/or characteristics of the resource with which the content item is to be presented (e.g., a position of one or more content item slots in the resource, a category of the resource, a type of the resource, an interactivity level of the resource, a ranking of the resource, a popularity of the resource, part or all of an address of the resource). In some implementations, the foregoing data may be appended to or included in a content item request URL (e.g., http://contentitem.item/page/contentitem?devid=abc123&devnfo=A34r0).

In one implementation, the content item request **202** includes a referral query and data indicative of the resource, including data indicative of the content of the resource and positional data indicative of the positions of one or more content item slots relative to the content of the resource. The data included with the content item request **202** may be received by the slot order prediction module **152** and used with a predictive model to output a content item slot order based, at least in part, on the referral query and the data indicative of the content of the resource, as will be described in greater detail below.

The slot order prediction module **152** is configured to use a predictive model to output an order for one or more content item slots of a resource. In one implementation, the slot order prediction module **152** may utilize aggregate historical data of interactions with the resource from an interactions database **160** to generate the predictive model. The aggregate historical data of interactions may include data indicative of whether the one or more content item slots of the resource was viewed, data indicative of a direction of scrolling relative to the one or more content item slots, data indicative of one or more referral search queries, data indicative of a viewable area of the resource associated with a referral query location, data indicative of aggregate demographic information of groups relative to the resource, data indicative of lengths of time spent viewing one or more portions of the resource, data indicative of one or more characteristics of client devices (e.g., a type of client device, a display type of a client device, dimensions of the display), data indicative of one or more characteristics of a web browser executed on client devices (e.g., a type of web browser), data indicative of one or more settings associated with client devices (e.g., a display resolution), data indicative of one or more settings associated with the web browser executed on client devices (e.g., a height of a web browser window, a width of a web browser window, a text size setting of the web browser of the client device, a font setting of the web browser, a zoom setting of the web browser, a dimension of one or more toolbar portions of the web browser, a dimension of one or more navigation and address portions of the web browser, a dimension of one or more bookmark portions of the web browser, a dimension of one or more tab portions of the web browser, a number of tabs open in the web browser, a dimension of a scroll bar of the web browser, formulae derived from dimensions of a web browser window and/or location of an area where a content item may be shown), and/or data indicative of one or more characteristics of the resource (e.g., a position of one or more content item slots in the resource, a category of the resource, a type of the resource, an interactivity level of the resource, a ranking of the resource, a popularity of the resource, part or all of an address of the resource).

The slot order prediction module **152** may generate the predictive model using a machine learning algorithm, such as a regression learning algorithm. Examples of such regression learning algorithms include perceptron linear learning, maximum entropy logistic regression, support vector machine (SVM) regression with maximum entropy gradient, descent least-squares stochastic gradient, etc.

In some implementations, the predictive model may be previously generated, either by the slot order prediction module **152** and/or by another module or system, and the slot order prediction module **152** may request and receive the predictive model from a database in which the predictive model is stored, such as the interactions database **160** or another database.

In some further implementations, if an order has been previously generated for the same or a substantially similar referral query and stored in a database, such as the interactions database **160** or another database, the slot order prediction module **152** may retrieve the order from the database.

The slot order prediction module **152** of the present implementation receives the data indicative of the resource, including data indicative of the content of the resource, and the referral query. The slot order prediction module **152** is configured to determine a referral query location using the data indicative of the resource and the referral query. Using the previous example, if the referral query (i.e., the search query that resulted in the user of the client device selecting the hyperlink for the resource) is "When and where was Albert Einstein born?," then the slot order prediction module **152** may parse through the data indicative of the content of the resource to determine a referral query location that is responsive to the referral query. That is, based on the query presented of "When and where was Albert Einstein born?," the slot order prediction module **152** determines the location in the content of the resource (e.g., the text having the location and date of birth) that is responsive to the query. The slot order prediction module **152** is configured to determine an order for the one or more content item slots of the resource based on the predictive model and the referral query location. In some implementations, the slot order prediction module **152** may also receive data associated with the client device. The data associated with the client device may be included in the content item request **202**. The data may be used by the slot order prediction module **152** as an input into the predictive model in addition to the referral query location and/or other input data.

The determined order may be used by the content item selection module **150** for the order of content item slots for an auction of third-party content items. Data for the third-party content items may be stored in a content item database **170** and/or may be stored in another storage device of the content item selection system **108** and/or in another system, such as a third-party content server **102** of FIG. **1**.

A first auction may be conducted for the first content item slot based on the order, a second auction may be conducted for the second content item slot based on the order, etc. In other implementations, the content item selection module **150** may perform a single auction for the one or more content item slots of the resource and may select the winning third-party content item in the first content item slot based on the order, the second place third-party content item in the second content item slot based on the order, etc. In still other implementations, the content item selection module **150** may rank several content items based on the auction. A number of content items may be selected based on the rank and the number of content item slots of the resource (e.g., if the resource has three content item slots, then the top three content items based on the ranking may be selected). The selected content items may be allocated to corresponding content item slots by the content item selection module **150**. Using the previous example, if three content items are selected, a first content item having the highest bid may be selected for a first content item slot based on the order, a second content item having the second highest bid may be selected for a second content item slot based on the order, etc. In another implementation, a first content item having the highest score may be selected for a first content item slot based on the order, a second content item having the second highest score may be selected for a second content item slot based on the order, etc. In still another implementation, a first content item having the highest relevance may be selected for a first content item slot based on the order, a second content item having the second highest relevance may be selected for a second content item slot based on the order, etc. In yet other implementations, values such as a pCTR value or a pCVR value may be used to select the first content item for the first content item slot based on the order, the second content item for the second content item slot based on the order, etc.

In some implementations, several referral query locations may be determined that are relevant to the referral query. In such instances, the slot order prediction module **152** may determine a set of referral query locations. In some implementations, the set of referral query locations may be ranked based upon relevance. Accordingly, when several referral query locations are utilized with a predictive model, the order may be generated based on the set of referral query locations.

Data to effect the display of the selected content items **204** may be transmitted or served by the content item selection module **150** to the client device and/or the resource server via the network **106**. The data to effect display of the selected content items **204** may include data indicative of the content item slot in which the content item is to be displayed.

In some implementations, a script may be generated by the content item selection system **108**. The script may be a JavaScript® script having one or more functions executable by a processing module of the client device on which the selected and served content items are to be displayed. In one example implementation, the script may include a function that receives data indicative of a direction of scrolling relative to the content of the resource. The data indicative of the direction of scrolling may be used to modify which content items are presented in which content item slots. That is, in one example implementation, the script may receive data indicative of the direction of scrolling and may modify the order and/or the presentation of the content items based on the direction of scrolling. For example, a resource may have three content item slots, slot one, slot two, and slot three, with slot one located at a top portion of the resource, slot two located at a midpoint portion of the resource, and slot three located at a bottom portion of the resource. An order determined by the slot order prediction module **152** may order the set of slots in an order of slot two, slot three, slot one. If, for example, data indicative of a direction of scrolling indicates an upward scroll, a content item that may originally be presented in slot three may be swapped with the content item originally to be presented in slot one, thereby resulting in a second-ranked content item being shown in slot one based on the user interaction. In some implementations, the script may include a delay until the referral query location is displayed within a viewable area of the resource (e.g., the referral query location upon which the order of content item slots is based, at least in part, is displayed on a display of the client device). Thus, the script may dynamically modify the presentation of content items in content items slots based, at least in part, on user interactions, such as data indicative of a direction of scrolling.

In some implementations, data may be output **206** from the client device to the content item selection system **108**.

For example, the outputted data **206** may include data indicative of whether the one or more content item slots of the resource was viewed, data indicative of a direction of scrolling relative to the one or more content item slots, data indicative of one or more referral search queries, data indicative of a viewable area of the resource associated with a referral query location, data indicative of lengths of time spent viewing one or more portions of the resource, data indicative of one or more characteristics of client devices (e.g., a type of client device, a display type of a client device, dimensions of the display), data indicative of one or more characteristics of a web browser executed on client devices (e.g., a type of web browser), data indicative of one or more settings associated with client devices (e.g., a display resolution), data indicative of one or more settings associated with the web browser executed on client devices (e.g., a height of a web browser window, a width of a web browser window, a text size setting of the web browser of the client device, a font setting of the web browser, a zoom setting of the web browser, a dimension of one or more toolbar portions of the web browser, a dimension of one or more navigation and address portions of the web browser, a dimension of one or more bookmark portions of the web browser, a dimension of one or more tab portions of the web browser, a number of tabs open in the web browser, a dimension of a scroll bar of the web browser, formulae derived from dimensions of a web browser window and/or location of an area where a content item may be shown), and/or data indicative of one or more characteristics of the resource (e.g., a position of one or more content item slots in the resource, a category of the resource, a type of the resource, an interactivity level of the resource, a ranking of the resource, a popularity of the resource, part or all of an address of the resource).

In some implementations, the outputted data **206** may be transmitted from the client device at the end of a page session (i.e., when a client device navigates away from the resource, when the web browser is closed, etc.). The outputted data **206** may be stored in the interactions database **160** such that the predictive model may be updated using the additional historical interaction data. Thus, the slot order prediction module **152** may further refine the outputted order for the content item slots based on the updated historical interaction data.

FIG. **3** depicts an implementation of a resource **300** having content **310**, such as first-party content, and two content item slots **320**, **330**, in which third-party content items may be served and displayed to a user of a client device viewing the resource **300** using a web browser. The content **310** includes a referral query location **312** that includes content relevant to the referral query that resulted in the resource **300** being selected by a user of a client device displaying the resource **300**. The referral query location **312** may include textual content, visual content (e.g., images or videos), or other content that is relevant based on the referral query. As discussed above, the referral query location **312** may be determined by the slot order prediction module **152** of the content item selection system **108**.

The referral query location **312** is used by the slot order prediction module **152** to determine an order of the content item slots **320**, **330**. In one example, the order may be determined based on the output of a predictive model based on aggregate historical data of interactions with the resource **300** and the referral query location **312**. In some implementations, the order may be based, at least in part, on a proximity of a location of a content item slot **320**, **330** relative to the referral query location **312**. For example, the order may result in the content item slot **320** being first and the content item slot **330** being second in the order. In some implementations, the proximity of the content item slots **320**, **330** may be included in the determination of the order by the predictive model.

In some implementations, a viewable area **340** of the resource **300** associated with the referral query location **312** may be utilized in determining the order of content item slots **320**, **330**. In the implementation shown, the viewable area **340** depicts content item slot **320** as viewable when the relevant content located at the referral query location **312** is on screen. Based on the viewable area **340** and the position of the referral query location **312**, content item slot **330** may be less likely to be visible in the viewable area **340** while the relevant content of the referral query location **312** is on screen. Accordingly, the viewable area **340** relative to the referral query location **312** may be used by the slot order prediction module **152** as an input for the predictive model in some implementations.

FIG. **4** depicts an implementation of a process **400** that may be used by the slot order prediction module **152** to generate a predictive model based on aggregate historical data of interactions. The process **400** includes receiving aggregate historical data of interactions (block **402**). The aggregate historical data of interactions may be received by the slot order prediction module **152** of the content item selection system **108** from an interactions database **160**.

The aggregate historical data of interactions may include data indicative of whether the one or more content item slots of the resource was viewed, data indicative of a direction of scrolling relative to the one or more content item slots, data indicative of one or more referral search queries, data indicative of a viewable area of the resource associated with a referral query location, data indicative of aggregate demographic information of groups relative to the resource, data indicative of lengths of time spent viewing one or more portions of the resource, data indicative of one or more characteristics of client devices (e.g., a type of client device, a display type of a client device, dimensions of the display), data indicative of one or more characteristics of a web browser executed on client devices (e.g., a type of web browser), data indicative of one or more settings associated with client devices (e.g., a display resolution), data indicative of one or more settings associated with the web browser executed on client devices (e.g., a height of a web browser window, a width of a web browser window, a text size setting of the web browser of the client device, a font setting of the web browser, a zoom setting of the web browser, a dimension of one or more toolbar portions of the web browser, a dimension of one or more navigation and address portions of the web browser, a dimension of one or more bookmark portions of the web browser, a dimension of one or more tab portions of the web browser, a number of tabs open in the web browser, a dimension of a scroll bar of the web browser, formulae derived from dimensions of a web browser window and/or location of an area where a content item may be shown), and/or data indicative of one or more characteristics of the resource (e.g., a position of one or more content item slots in the resource, a category of the resource, a type of the resource, an interactivity level of the resource, a ranking of the resource, a popularity of the resource, part or all of an address of the resource).

A predictive model to determine an order of content item slots is generated based on the aggregate historical data of interactions (block **404**). In some implementations, a predictive model may be generated for each resource. In other implementations, a predictive model may be generated for

each resource for each referral query. In still other implementations, a predictive model may be generated for each resource for each group profile based on aggregate demographic information. In another implementation, the predictive models may be generated for each referral query for each resource and for each group profile based on aggregate demographic information.

In some implementations, the generated predictive model or models may be stored in a database, such as the interactions database **160**, such that the predictive model or models may be used by the slot order prediction module **152** in response to the same or a substantially similar content item request and/or referral query. In some implementations, each predictive model may include a unique identifier. In some implementations, the process **400** may receive additional aggregate historical data of interactions (block **402**) and may update the predictive model or regenerate the predictive model (block **404**) base on the additional aggregate historical data of interactions.

FIG. **5** depicts an implementation of a process **500** for determining an order for content item slots and outputting data to effect display of content items in the content item slots based on the order. The process **500** includes receiving data indicative of a resource and a referral query (block **502**). The data indicative of the resource may include data indicative of the content of the resource and data indicative of the positions of one or more content item slots relative to the content of the resource. The data indicative of the resource may include code for the resource, such as HTML code. The resource may include one or more content item slots. In some implementations, the resource may include a first content item slot and a second content item slot. In other implementations, the resource may have a set of content item slots.

The data indicative of the referral query may include one or more search terms used in a search query that the resource was selected as responsive to. Using the above example, a search query for "When and where was Albert Einstein born?" may be parsed into search terms of "When," "and," "where," "was," "Albert," "Einstein," and "born." In some implementations, stop words (e.g., words such as "a," "and," "or" etc.) may be removed from the search query terms. In some implementations, the search query may be configured to recognize formal or other special search terms, such as state names, country names, famous names, etc. such that, in the present example, a search term for "Albert Einstein" may be preserved as a single search term. The data indicative of the resource and the referral query may be received by the slot order prediction module **152** of the content item selection system **108**, in some implementations.

A referral query location of the resource is determined (block **504**). In some implementations, the slot order prediction module **152** may determine the referral query location of the resource. In other implementations, other modules of the content item selection system **108** may determine the referral query location. The referral query location is determined based on the referral query and data indicative of the content of the resource. That is, one or more terms of the referral query may be compared to the data indicative of the content of the resource. In some implementations, a single referral query location may be determined based on the best match of the content of the resource to the terms of the referral query. In other implementations, several referral query locations may be determined. For example, if the referral query (i.e., the search query that resulted in the user of the client device selecting the hyperlink for the resource) is "When and where was Albert Einstein born?," then the slot order prediction module **152** may parse through the data indicative of the content of the resource to determine a referral query location that is responsive to the referral query. That is, based on the query presented of "When and where was Albert Einstein born?," the slot order prediction module **152** determines the location in the content of the resource (e.g., the text having the location and date of birth) that is responsive to the query.

An order for a first content item slot and a second content item slot is determined based on a predictive model and the referral query location (block **506**). The referral query location and the location of the first content item slot may be used as inputs to the predictive model. The predictive model may output a value, such as a score, based on the referral query location and the location of the first content item slot. In some implementations, data associated with the client device may be input into the predictive model as well. The referral query location and the location of the second content item slot may also be used as inputs to the predictive model to output a second value, such as a score, based on the referral query location and the location of the second content item slot. In some implementations, data associated with the client device may be input into the predictive model as well.

Of course, additional data may be input into the predictive model to generate the first and second values. For example, data indicative of one or more characteristics of the client device (e.g., a type of client device, a display type of a client device, dimensions of the display), data indicative of one or more characteristics of a web browser executed on the client device (e.g., a type of web browser), data indicative of one or more settings associated with the client device (e.g., a display resolution), data indicative of one or more settings associated with the web browser executed on the client device (e.g., a height of a web browser window, a width of a web browser window, a text size setting of the web browser of the client device, a font setting of the web browser, a zoom setting of the web browser, a dimension of one or more toolbar portions of the web browser, a dimension of one or more navigation and address portions of the web browser, a dimension of one or more bookmark portions of the web browser, a dimension of one or more tab portions of the web browser, a number of tabs open in the web browser, a dimension of a scroll bar of the web browser, formulae derived from dimensions of a web browser window and/or location of an area where a content item may be shown), and/or data indicative of one or more characteristics of the resource (e.g., a position of one or more content item slots in the resource, a category of the resource, a type of the resource, an interactivity level of the resource, a ranking of the resource, a popularity of the resource, part or all of an address of the resource).

Based on the values, the first content item slot and the second content item slot may be ranked to determine the order. For example, if the first value for the first content item slot is 0.732 and the second value for the second content item slot is 0.634, then the order determined for the first content item slot and the second content item slot may be the first content item slot followed by the second content item slot. In another example with three content item slots, if the first value for the first content item slot is 0.732, the second value for the second content item slot is 0.634, and a third value for a third content item slot is 0.713, then the order determined for the content item slots may be the first content item slot followed by the third content item slot followed by the second content item slot.

In some implementations, the determined order and the referral query may be stored (block **508**). The determined

order and the referral query may be stored as a static content item slot order for the resource based on the referral query. The static content item slot order may be stored in a database, such as the interactions database **160** and/or another database. The static content item slot order may be associated with data indicative of the referral query such that, if the same or a similar referral query is received with a subsequent content item request for the resource, the static order may be retrieved and used by the content item selection system **108**.

Data to effect display of a first content item for display in the first content item slot and data to effect display of a second content item for display in the second content item slot may be outputted (block **510**). The outputted data may be transmitted from the content item selection system **108** to a client device **110** and/or resource server **104** via the network **106**. In some implementations, the outputted data may include data, such as an identifier, to indicate which content item is to be shown in which content item slot.

In other implementations, the content item selection system **108** may output the data to effect display the content items based on a linear order of the content item slots. That is, for a content item-ordered set of slot two-content item one, slot three-content item two, slot one-content item three, the content item selection system **108** may output data to effect display of content item three first (to be displayed in content item slot one), data to effect display of content item one second (to be displayed in content item slot two), and data to effect display of content item two third (to be displayed in content item slot three). Thus, the client device may simply display the content items in the slots and order in which the data to effect display is received by the client device.

In some implementations, a first content item to be displayed in a first content item slot based on the determined order may be associated with a first value and a second content item to be displayed in a second content item slot based on the determined order may be associated with a second value. The first value may be greater than the second value. In one implementation, the first content item may be selected to be displayed in the first content item slot of the determined order based on the first content item having the highest bid and the second content item may be selected to be displayed in the second content item slot of the determined order based on the second content item having the second highest bid. In another implementation, the first content item may be selected to be displayed in the first content item slot of the determined order based on the first content item having the highest score and the second content item may be selected to be displayed in the second content item slot of the determined order based on the second content item having the second highest score. In still another implementation, the first content item may be selected to be displayed in the first content item slot of the determined order based on the first content item having the highest relevance and the second content item may be selected to be displayed in the second content item slot of the determined order based on the second content item having the second highest relevance. Of course, other values may be used to determine which content item is selected to be displayed in each content item slot of the order.

FIG. **6** depicts another implementation of a process **600** for determining an order for content item slots and outputting data to effect display of content items in the content item slots based on the order. Blocks **602**, **604**, **606**, **608**, and **612** of process **600** may be substantially similar to those described in reference to blocks **502**, **504**, **506**, **508**, and **510** of FIG. **5**, respectively.

Process **600** further includes generating a script configured to modify the order (block **610**). The script may be a JavaScript® script having one or more functions executable by a processing module of a client device on which selected and served content items are to be displayed. In one example implementation, the script may include a function that receives data indicative of a direction of scrolling relative to the content of the resource. The data indicative of the direction of scrolling may be used to modify which content items are presented in which content item slots. That is, in one example implementation, the script may receive data indicative of the direction of scrolling and may modify the order and/or the presentation of the content items based on the direction of scrolling. For example, a resource may have three content item slots, slot one, slot two, and slot three, with slot one located at a top portion of the resource, slot two located at a midpoint portion of the resource, and slot three located at a bottom portion of the resource. An order determined by the slot order prediction module **152** may order the set of slots in an order of slot two, slot three, slot one. If, for example, data indicative of a direction of scrolling indicates an upward scroll, a content item that may originally be presented in slot three may be swapped with the content item originally to be presented in slot one, thereby resulting in a second-ranked content item being shown in slot one based on the user interaction. In some implementations, the script may include a delay until the referral query location is displayed within a viewable area of the resource (e.g., the referral query location upon which the order of content item slots is based, at least in part, is displayed on a display of the client device). Thus, the script may dynamically modify the presentation of content items in content items slots based, at least in part, on user interactions, such as data indicative of a direction of scrolling.

The generated script may be transmitted with the data to effect display of a first content item to be displayed in the first content item slot and data to effect display of a second content item to be displayed in the second content item slot (block **612**).

FIG. **7** depicts still another implementation of a process **700** for determining an order for content item slots and outputting data to effect display of content items in the content item slots based on the order. The process **700** includes receiving data indicative of a resource having a set of content item slots and data indicative of a referral query (block **702**). The data indicative of the resource may include data indicative of the content of the resource and data indicative of a position or location associated with each content item slot of the set of content item slots relative to the content of the resource. The data indicative of the resource may include code for the resource, such as HTML code.

The data indicative of the referral query may include one or more search terms used in a search query that the resource was selected as responsive to. Using the above example, a search query for "When and where was Albert Einstein born?" may be parsed into search terms of "When," "and," "where," "was," "Albert," "Einstein," and "born." In some implementations, stop words (e.g., words such as "a," "and," "or" etc.) may be removed from the search query terms. In some implementations, the search query may be configured to recognize formal or other special search terms, such as state names, country names, famous names, etc. such that, in the present example, a search term for "Albert Einstein" may

be preserved as a single search term. The data indicative of the resource and the referral query may be received by the slot order prediction module **152** of the content item selection system **108**, in some implementations.

A referral query location of the resource is determined (block **704**). In some implementations, the slot order prediction module **152** may determine the referral query location of the resource. In other implementations, other modules of the content item selection system **108** may determine the referral query location. The referral query location is determined based on the referral query and data indicative of the content of the resource. That is, one or more terms of the referral query may be compared to the data indicative of the content of the resource. In some implementations, a single referral query location may be determined based on the best match of the content of the resource to the terms of the referral query. In other implementations, several referral query locations may be determined. For example, if the referral query (i.e., the search query that resulted in the user of the client device selecting the hyperlink for the resource) is "When and where was Albert Einstein born?," then the slot order prediction module **152** may parse through the data indicative of the content of the resource to determine a referral query location that is responsive to the referral query. That is, based on the query presented of "When and where was Albert Einstein born?," the slot order prediction module **152** determines the location in the content of the resource (e.g., the text having the location and date of birth) that is responsive to the query.

A content item slot order for the set of content item slots is determined based, at least in part, on a corresponding proximity of a corresponding location of each content item slot of the set of content item slots (block **706**) relative to the referral query location. For example, a content item slot that is nearest to the referral query location may be first in the order and a content item slot that is furthest from the referral query location may be last in the order. In some implementations, the determining of the content item slot order for the set of content item slots may be further based, at least in part, on a set of outputs from a predictive model. Each output of the set of outputs corresponds to a content item slot of the set of content item slots. The predictive model and the corresponding outputs may be substantially similar to that described above in reference to block **506** of FIG. **5**. The predictive model may be based on aggregate historical data of interactions with the resource, which may include data indicative of whether the first content item slot was viewed, data indicative of whether the second content item slot was viewed, data indicative of a direction of scrolling, data indicative of a viewable area of the resource associated with the referral query location, and/or other data described herein.

Data to effect display of a first content item associated with a first content item slot based on the content item slot order may be served to a client device or a resource server (block **708**). The data may be transmitted from the content item selection system **108** to a client device **110** and/or resource server **104** via the network **106**. In some implementations, the first content item is selected based, at least in part, on a value from a content item auction. The value may include a bid value, a score value, a relevance value, a pCTR value, a pCVR value, etc. Of course, other values may be used to determine which content item is selected to be displayed in each content item slot of the order.

In some implementations, data to effect display of a second content item associated with a second content item slot based on the content item slot order may be served to a client device or a resource server (block **710**). The data may be transmitted from the content item selection system **108** to a client device **110** and/or resource server **104** via the network **106**. The second content item slot may be after the first content item slot in the content item slot order. In some implementations, the second content item is selected based, at least in part, on a value from a content item auction. The value may include a bid value, a score value, a relevance value, a pCTR value, a pCVR value, etc. Of course, other values may be used to determine which content item is selected to be displayed in each content item slot of the order.

FIG. **8** depicts still another implementation of a process **800** for determining an order for content item slots and serving data to effect display of content items in the content item slots based on the order. The process **800** includes receiving data indicative of a resource and a referral query (block **802**). The data indicative of the resource may include data indicative of the content of the resource and data indicative of the locations of one or more content item slots relative to the content of the resource. The data indicative of the resource may include code for the resource, such as HTML code. The resource may include one or more content item slots. In some implementations, the resource may include a first content item slot at a first location and a second content item slot at a second location.

The data indicative of the referral query may include one or more search terms used in a search query that the resource was selected as responsive to. Using the above example, a search query for "When and where was Albert Einstein born?" may be parsed into search terms of "When," "and," "where," "was," "Albert," "Einstein," and "born." In some implementations, stop words (e.g., words such as "a," "and," "or" etc.) may be removed from the search query terms. In some implementations, the search query may be configured to recognize formal or other special search terms, such as state names, country names, famous names, etc. such that, in the present example, a search term for "Albert Einstein" may be preserved as a single search term. The data indicative of the resource and the referral query may be received by the slot order prediction module **152** of the content item selection system **108**, in some implementations.

A referral query location of the resource is determined (block **804**). The determination of the referral query location of the resource may be substantially similar to that described above in reference to block **504** of FIG. **5**.

The process **800** further includes determining a first proximity of a first content item slot based on the first location and the referral query location (block **806**). In some implementations, the proximity may be a vertical distance from the first location to the referral query location. In other implementations, such as resources having offset content item slots, such as those shown in FIG. **3**, the proximity may include a horizontal distance, either in addition to or in lieu of the vertical distance.

The process **800** also includes determining a second proximity of a second content item slot based on the second location and the referral query location (block **806**). In some implementations, the proximity may be a vertical distance from the first location to the referral query location. In other implementations, such as resources having offset content item slots, such as those shown in FIG. **3**, the proximity may include a horizontal distance, either in addition to or in lieu of the vertical distance. In some instances, the first proximity may be less than the second proximity. In other instances, the first proximity may be greater than the second proximity.

In still other instances, the first proximity and the second proximity may be substantially equal.

The process **800** includes receiving a first content item and a second content item (block **810**). In some implementations, the first content item and the second content item may be selected based on a ranking of third-party content items performed by the content item selection module **150** of the content item selection system **108**. In an implementation, the content item selection module **150** may rank several third-party content items based on an auction. In other implementations, the content item selection module **150** may rank the third-party content items based on a bid value, a score value, a relevance value, a pCTR value, a pCVR value, etc. The content item selection module **150** may select the first content item and the second content item based on the content items being the first and second content items in the resulting ranking, respectively.

Data to effect display of the first content item associated with a first content item slot based on the first proximity and data to effect display of the second content item associated with a second content item slot based on the second proximity may be served to a client device or a resource server (block **812**). The data may be transmitted from the content item selection system **108** to a client device **110** and/or resource server **104** via the network **106**.

In some implementations, the first content item is associated with a first bid value and the second content item is associated with a second bid value. The first bid value may be greater than the second bid value. The first content item may be associated with the first content item slot further based, at least in part, on the first bid value and the second content item may be associated with the second content item slot further based, at least in part, on the second bid value. In some implementations, the first content item may be associated with the first content item slot further based on a first output of a predictive model and the second content item may be associated with the second content item slot further based on a second output of the predictive model. The predictive model and the corresponding outputs may be substantially similar to that described above in reference to block **506** of FIG. **5**. The predictive model may be generated based, at least in part, on aggregate historical data of interactions with the resource, which may include data indicative of whether the first content item slot was viewed, data indicative of whether the second content item slot was viewed, data indicative of a direction of scrolling, data indicative of a viewable area of the resource associated with the referral query location, and/or other data described herein.

FIG. **9** is a block diagram of a computer system **900** that can be used to implement the client device **110**, content item selection system **108**, third-party content server **102**, resource server **104**, etc. The computing system **900** includes a bus **905** or other communication component for communicating information and a processor **910** or processing module coupled to the bus **905** for processing information. The computing system **900** can also include one or more processors **910** or processing modules coupled to the bus for processing information. The computing system **900** also includes main memory **915**, such as a RAM or other dynamic storage device, coupled to the bus **905** for storing information, and instructions to be executed by the processor **910**. Main memory **915** can also be used for storing position information, temporary variables, or other intermediate information during execution of instructions by the processor **910**. The computing system **900** may further include a ROM **920** or other static storage device coupled to the bus **905** for storing static information and instructions for the processor **910**. A storage device **925**, such as a solid state device, magnetic disk or optical disk, is coupled to the bus **905** for persistently storing information and instructions. Computing device **900** may include, but is not limited to, digital computers, such as laptops, desktops, workstations, personal digital assistants, servers, blade servers, mainframes, cellular telephones, smart phones, mobile computing devices (e.g., a notepad, e-reader, etc.) etc.

The computing system **900** may be coupled via the bus **905** to a display **935**, such as a Liquid Crystal Display (LCD), Thin-Film-Transistor LCD (TFT), an Organic Light Emitting Diode (OLED) display, LED display, Electronic Paper display, Plasma Display Panel (PDP), and/or other display, etc., for displaying information to a user. An input device **930**, such as a keyboard including alphanumeric and other keys, may be coupled to the bus **905** for communicating information and command selections to the processor **910**. In another implementation, the input device **930** may be integrated with the display **935**, such as in a touch screen display. The input device **930** can include a cursor control, such as a mouse, a trackball, or cursor direction keys, for communicating direction information and command selections to the processor **910** and for controlling cursor movement on the display **935**.

According to various implementations, the processes and/or methods described herein can be implemented by the computing system **900** in response to the processor **910** executing an arrangement of instructions contained in main memory **915**. Such instructions can be read into main memory **915** from another computer-readable medium, such as the storage device **925**. Execution of the arrangement of instructions contained in main memory **915** causes the computing system **900** to perform the illustrative processes and/or method steps described herein. One or more processors in a multi-processing arrangement may also be employed to execute the instructions contained in main memory **915**. In alternative implementations, hard-wired circuitry may be used in place of or in combination with software instructions to effect illustrative implementations. Thus, implementations are not limited to any specific combination of hardware circuitry and software.

Although an implementation of a computing system **900** has been described in FIG. **9**, implementations of the subject matter and the functional operations described in this specification can be implemented in other types of digital electronic circuitry, or in computer software, firmware, or hardware, including the structures disclosed in this specification and their structural equivalents, or in combinations of one or more of them.

Implementations of the subject matter and the operations described in this specification can be implemented in digital electronic circuitry, or in computer software embodied on a tangible medium, firmware, or hardware, including the structures disclosed in this specification and their structural equivalents, or in combinations of one or more of them. The subject matter described in this specification can be implemented as one or more computer programs, i.e., one or more modules of computer program instructions, encoded on one or more computer storage media for execution by, or to control the operation of, data processing apparatus. Alternatively or in addition, the program instructions can be encoded on an artificially-generated propagated signal, e.g., a machine-generated electrical, optical, or electromagnetic signal that is generated to encode information for transmission to suitable receiver apparatus for execution by a data processing apparatus. A computer storage medium can be, or

be included in, a computer-readable storage device, a computer-readable storage substrate, a random or serial access memory array or device, or a combination of one or more of them. Moreover, while a computer storage medium is not a propagated signal, a computer storage medium can be a source or destination of computer program instructions encoded in an artificially-generated propagated signal. The computer storage medium can also be, or be included in, one or more separate components or media (e.g., multiple CDs, disks, or other storage devices). Accordingly, the computer storage medium is both tangible and non-transitory.

The operations described in this specification can be performed by a data processing apparatus on data stored on one or more computer-readable storage devices or received from other sources.

The terms "data processing apparatus," "computing device," "processing circuit," or "processing module" encompass all kinds of apparatus, devices, and machines for processing data, including by way of example a programmable processor, a computer, a system on a chip, or multiple ones, a portion of a programmed processor, or combinations of the foregoing. The apparatus can include special purpose logic circuitry, e.g., an FPGA or an ASIC. The apparatus can also include, in addition to hardware, code that creates an execution environment for the computer program in question, e.g., code that constitutes processor firmware, a protocol stack, a database management system, an operating system, a cross-platform runtime environment, a virtual machine, or a combination of one or more of them. The apparatus and execution environment can realize various different computing model infrastructures, such as web services, distributed computing and grid computing infrastructures.

A computer program (also known as a program, software, software application, script, or code) can be written in any form of programming language, including compiled or interpreted languages, declarative or procedural languages, and it can be deployed in any form, including as a standalone program or as a module, component, subroutine, object, or other unit suitable for use in a computing environment. A computer program may, but need not, correspond to a file in a file system. A program can be stored in a portion of a file that holds other programs or data (e.g., one or more scripts stored in a markup language document), in a single file dedicated to the program in question, or in multiple coordinated files (e.g., files that store one or more modules, sub-programs, or portions of code). A computer program can be deployed to be executed on one computer or on multiple computers that are located at one site or distributed across multiple sites and interconnected by a communication network.

Processors suitable for the execution of a computer program include, by way of example, both general and special purpose microprocessors, and any one or more processors of any kind of digital computer. Generally, a processor will receive instructions and data from a read-only memory or a random access memory or both. The essential elements of a computer are a processor for performing actions in accordance with instructions and one or more memory devices for storing instructions and data. Generally, a computer will also include, or be operatively coupled to receive data from or transfer data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto-optical disks, or optical disks. However, a computer need not have such devices. Moreover, a computer can be embedded in another device, e.g., a mobile telephone, a personal digital assistant (PDA), a mobile audio or video player, a game console, a Global Positioning System (GPS) receiver, or a portable storage device (e.g., a universal serial bus (USB) flash drive), to name just a few. Devices suitable for storing computer program instructions and data include all forms of non-volatile memory, media and memory devices, including by way of example semiconductor memory devices, e.g., EPROM, EEPROM, and flash memory devices; magnetic disks, e.g., internal hard disks or removable disks; magneto-optical disks; and CD-ROM and DVD disks. The processor and the memory can be supplemented by, or incorporated in, special purpose logic circuitry.

To provide for interaction with a user, implementations of the subject matter described in this specification can be implemented on a computer having a display device, e.g., a CRT (cathode ray tube) or LCD monitor, for displaying information to the user and a keyboard and a pointing device, e.g., a mouse or a trackball, by which the user can provide input to the computer. Other kinds of devices can be used to provide for interaction with a user as well; for example, feedback provided to the user can be any form of sensory feedback, e.g., visual feedback, auditory feedback, or tactile feedback; and input from the user can be received in any form, including acoustic, speech, or tactile input.

While this specification contains many specific implementation details, these should not be construed as limitations on the scope of what may be claimed, but rather as descriptions of features specific to particular implementations. Certain features described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

Similarly, while operations are depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described program components and systems can generally be integrated in a single software product or packaged into multiple software products embodied on tangible media.

References to "or" may be construed as inclusive so that any terms described using "or" may indicate any of a single, more than one, and all of the described terms.

Thus, particular implementations of the subject matter have been described. Other implementations are within the scope of the following claims. In some cases, the actions recited in the claims can be performed in a different order and still achieve desirable results. In addition, the processes depicted in the accompanying figures do not necessarily require the particular order shown, or sequential order, to achieve desirable results. In certain implementations, multitasking and parallel processing may be advantageous.

The claims should not be read as limited to the described order or elements unless stated to that effect. It should be understood that various changes in form and detail may be

made by one of ordinary skill in the art without departing from the spirit and scope of the appended claims. All implementations that come within the spirit and scope of the following claims and equivalents thereto are claimed.

What is claimed is:

1. A method of serving content items in content item slots comprising:

receiving, at a processing module, data indicative of a resource and a referral query, wherein the resource has a first content item slot and a second content item slot;

determining, using the processing module and by parsing content on the resource, a location of the referral query on the resource;

determining, using the processing module, a first spatial distance between the first content item slot and the location of the referral query;

determining, using the processing module, a second spatial distance between the second content item slot and the location of the referral query;

identifying, by the processing module, a first rank of a first content item and a second rank of a second content item;

selecting the first content item for display in the first content item slot and the second content item for display in the second content item slot responsive to determining that the first spatial distance is less than the second spatial distance and the first rank is higher than the second rank; and

transmitting data to effect display of the first content item in the first content item slot and data to effect display of the second content item in the second content item slot.

2. A system for serving content items in content item slots comprising:

one or more processing modules; and one or more storage devices storing instructions that, when executed by the one or more processing modules, cause the one or more processing modules to perform operations comprising:

receiving data indicative of a resource and a referral query, wherein the resource has a first content item slot and a second content item slot;

determining, by parsing content on the resource, a location of the referral query on the resource;

determining a first spatial distance between the first content item slot and the location of the referral query;

determining, a second spatial distance between the second content item slot and the location of the referral query;

identifying a first rank of a first content item and a second rank of a second content item;

selecting the first content item for display in the first content item slot and the second content item for display in the second content item slot responsive to determining that the first spatial distance is less than the second spatial distance and the first rank is higher than the second rank; and

transmitting data to effect display of the first content item in the first content item slot and data to effect display of the second content item in the second content item slot.

3. The system of claim **2**, wherein determining that the first spatial distance is less than the second spatial distance is based on a set of outputs from a predictive model.

4. The system of claim **3**, wherein the predictive model is based, at least in part, on aggregate historical data of interactions with the resource.

5. The system of claim **4**, wherein the historical data of interactions with the resource comprises data indicating at least that the first content item slot was viewed, the second content item slot was viewed, or the direction of scrolling.

6. The system of claim **5**, wherein the historical data of interactions with the resource further comprises data indicative of a viewable area of the resource associated with the referral query location.

7. A non-transitory computer readable storage device storing instructions that, when executed by one or more processing modules, cause the one or more processing modules to perform operations comprising:

receiving data indicative of a resource and a referral query, wherein the resource has a first content item slot and a second content item slot;

determining, by parsing content on the resource, a location of the referral query on the resource;

determining a first spatial distance between the first content item slot and the location of the referral query;

determining a second spatial distance between the second content item and the location of the referral query;

identifying a first rank of a first content item and a second rank of a second content item;

selecting the first content item for display in the first content item slot and the second content item for display in the second content item slot responsive to determining that the first spatial distance is less than the second spatial distance and the first rank is higher than the second rank; and

serving, to a client device, data to effect display of a first content item in the first content item slot and data to effect display of a second content item in the second content item slot.

* * * * *